Navy Warfare Development Command

13th Navy Technical Interchange

Chief Engineer
Director, Modeling and Simulation
Navy Warfare Development Command

MBGIE Technical Objectives

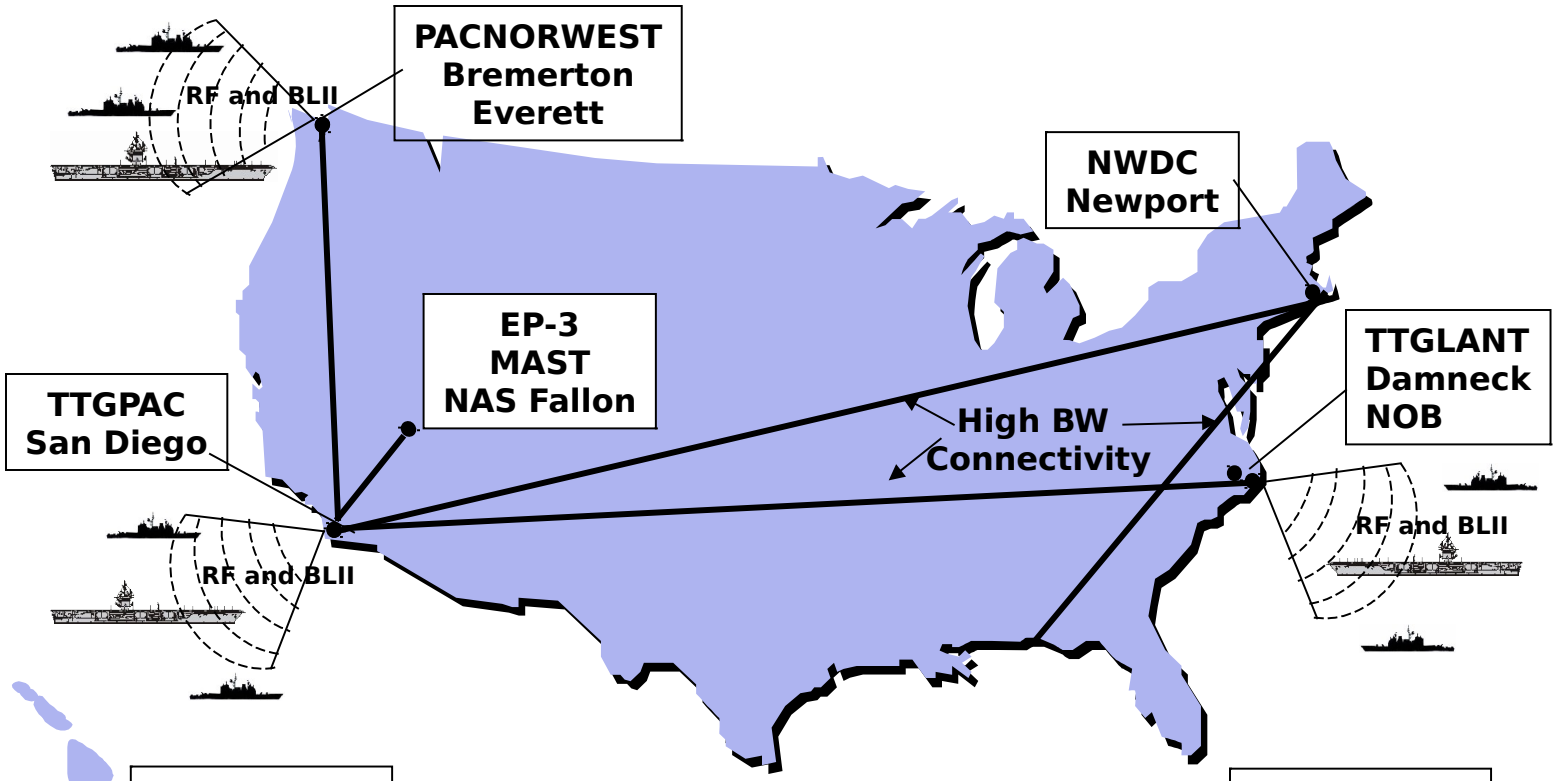
- Establish a Navy Continuous Training Environment (NCTE) Architecture and east/west coast baseline for Strike Group and Multi-Strike Group Training.
- Integrate the Battle Force Tactical Training Architecture and design in consideration of legacy limitations into the NCTE.
- Design with JNTC requirements, as we understand them, in mind. Develop and propose standards for the JNTC Architecture

Technical Challenges

- 4 Months to design, engineer, install, contract, test, integrate, rehearse, document
- Solve key technology issues
  - Simulation Loading (2500 entity scenario to systems capable of 128 entities)
- Interface LOS radio capability among Fleet Concentration Areas
- Test with inconsistent availability of participants
- Reroute east coast SIPRnet and build new TDL path due to HREN failure

Required team of dedicated Professional Modeling and Simulation Engineers

MBGIE Architectural Concept



Link
OTH-Gold
TACELINT
TACREP
Voice Nets
VTC

Link
OTH-Gold
TACELINT
TACREP
Voice Nets
VTC

One, common, geographic-centric environment

Simulation Data Management

JSAF
DDM
JSAF
DDM
JSAF

DDM

HLA/ DIS GW

Geographic Filter

BFTT TDL
NES Based
DIS Broadcast
Network

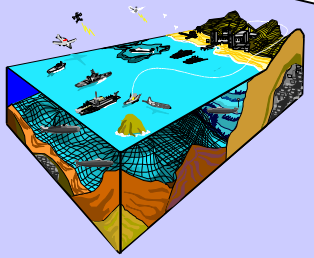
DIS/DIS GW

Geographic Filter

Theater - wide Area of Interest

Strike Force Area of Interest

Unit Sensor Determined Area of Interest



> 50K Entities

> 800 Entities

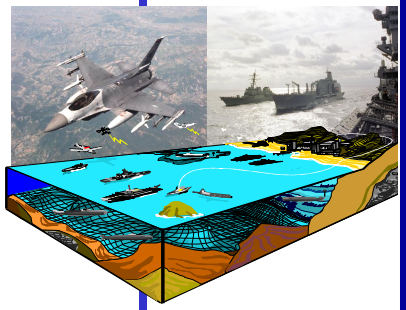
> 128/256 Entitie

Simulation to C4I

Stimulating the War Fighter

Simulation Environment

Core JSAF Simulati



HLA Environment

Interface

C4I Generation

Information Communications

ASSET	Nat'l ELINT TAB 37	SIPR to NMCC TDDS to Ships
AUTO SIGS	Nat'l Imagery NITF 2.0	SIPR to ONI JCA to Ships
U2 TENCAP	SAR/IR	DREN to TTGs BLII to Ships
C4I GW	OTH Gold USMTF ELINT MEDAL TACFIRE	DREN to TTGs SIPR to Ships
Predator JSTARS MUSE	Streaming Video/MTI Telemetry	DREN to TTGs BLII to Ships
MLST3	TADIL J TADIL A	DREN to TTGs JTIDS to Ships
HLA/DIS XFACE	DIS Simulation	DREN to TTGs BLII to Ships
IT Apps	Voice/VTC Control	DREN to TTGs Radios to Ships

TDDS

JCA

Decision Environment

TBMCS

PTW

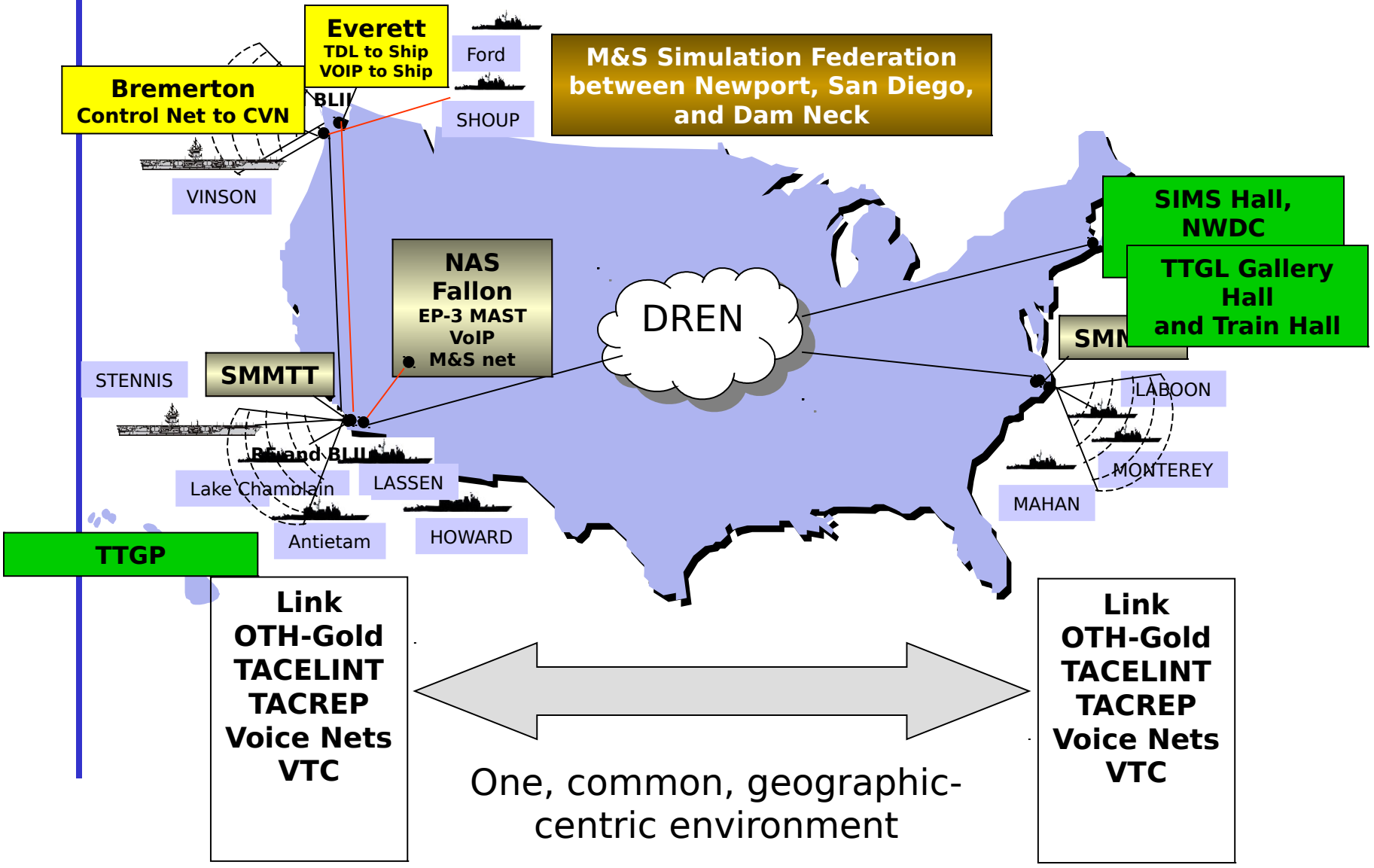
IPL

CBTSYS

MIDS/ IDB

GCCS-M

MBGIE Architectural Concept



Addressing Standards

- Entrée to Navy Inport Training Architecture
- High Level Architecture simulation baseline
- HLA/DIS Interface Specification and Hardware
- H323 Voice and VTC Communications Standards and Specification (Not a simulation standard such as ASTi)
- Link 11 and Link 16 Interface Specification
- Network responsibilities and divisions
  - Simulation (dedicated)
  - Control (Voice, data, VTC) dedicated
  - Operations (SIPRnet)

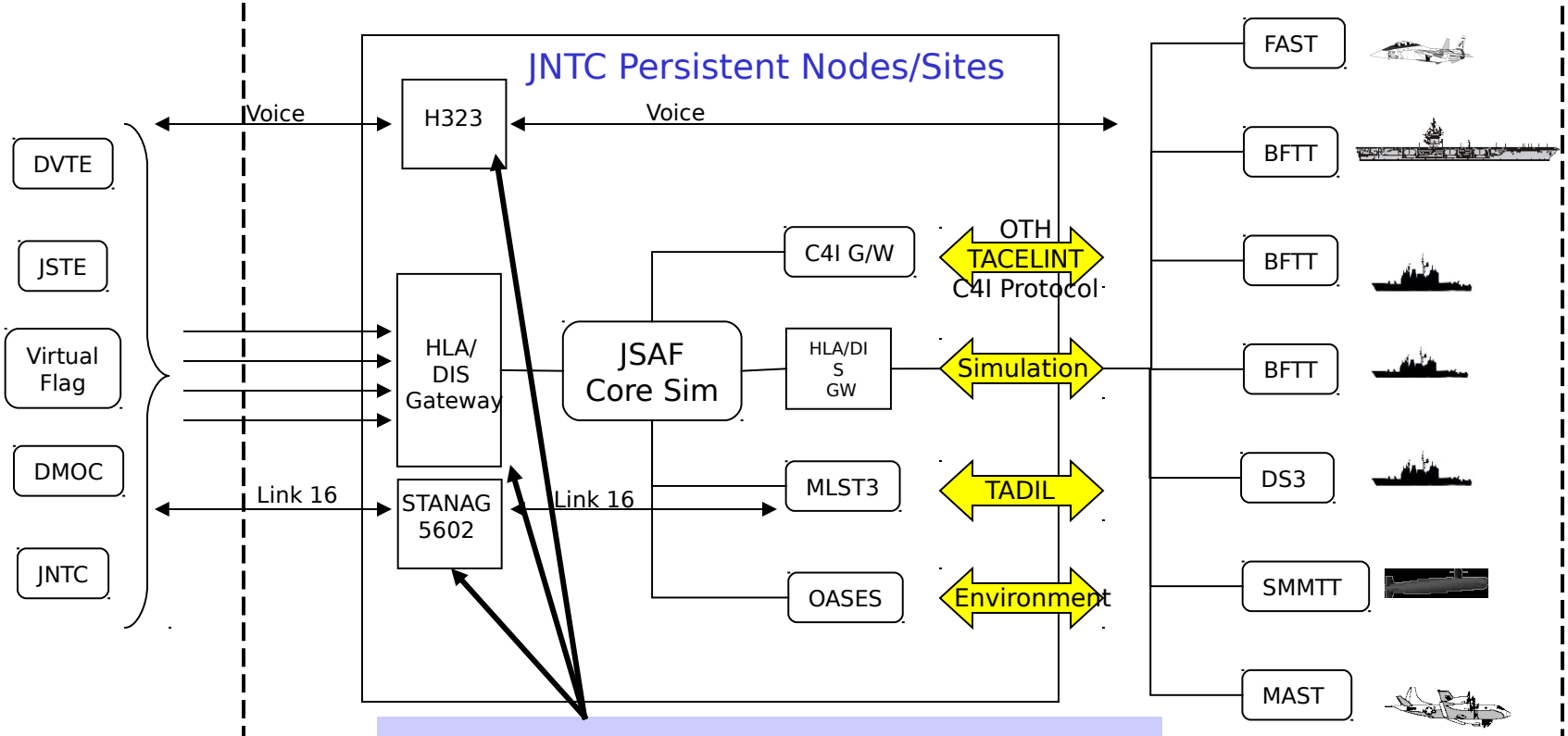
Communications Architecture and Standards

- Design and Architecture support future growth
- Support three required networks
  - Red Simulation Net
  - Red Voice, VTC and Data Net
  - Black Voice, VTC, and Data Net
- Layer 2 ATM Long Haul circuit
  - DATMS, DREN, DISN-LES
  - Fast ATM Encryption of all three networks required for simulation and VoIP
- Layer 3 Supports Multicast
  - Supports simulation subscription groups for simulation scalability issues
  - Supports bandwidth conservation of multicast applications
  - Supports MCU conferencing scalability issues
  - Isolates Simulation PIM Dense mode and data PIM Sparse modes
- Layer 3 and 4 Support of COS and QOS
  - Supports H323 VTC and VoIP

Design Incorporates

- Long Haul connectivity among central nodes at San Diego, Dam Neck, Newport, JFCOM
- Metropolitan connectivity between TTGs
- Ready for future connectivity to EWTGs and FITC/NMITC
- Uses VoIP as intercom and long haul voice and tie between LOS radios coast to coast
- Allows hundreds of “nets” to be setup via S/W and MCUs
- VoIP ties into uncovered radios and public phone switch on Black side
- VoIP ties into encrypted radios on Red Side
- Data ties into SIPRnet on Red Side
- Will support both H323 and H320 VTC coast to coast
- Simulation ties into pier side distribution on Red Side (places all controls for VTC in the hands of the trainers)

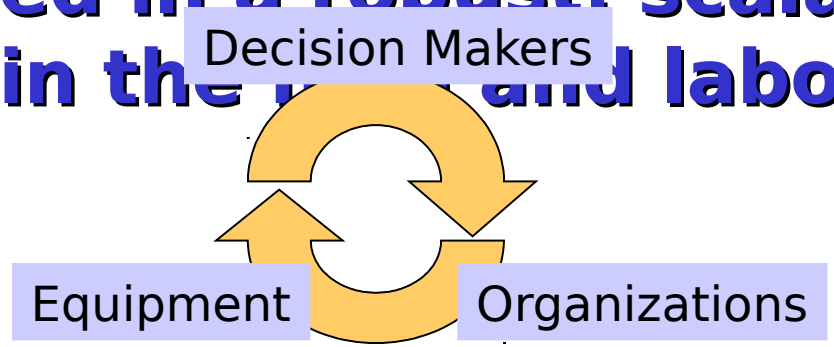
Inport Architecture



- **Gateways and specifications maintain configuration management on each side**
- **Define Interface Specification to the Navy Training Architecture**

NWDC M&S and Engineering Methodology

To create a simulated environment where war fighting concepts involving process (Doctrine & TTP), organizations, and technologies can be "end to end," repeatedly stimulated in a robust, scalable manner in the [illegible] and laboratory.

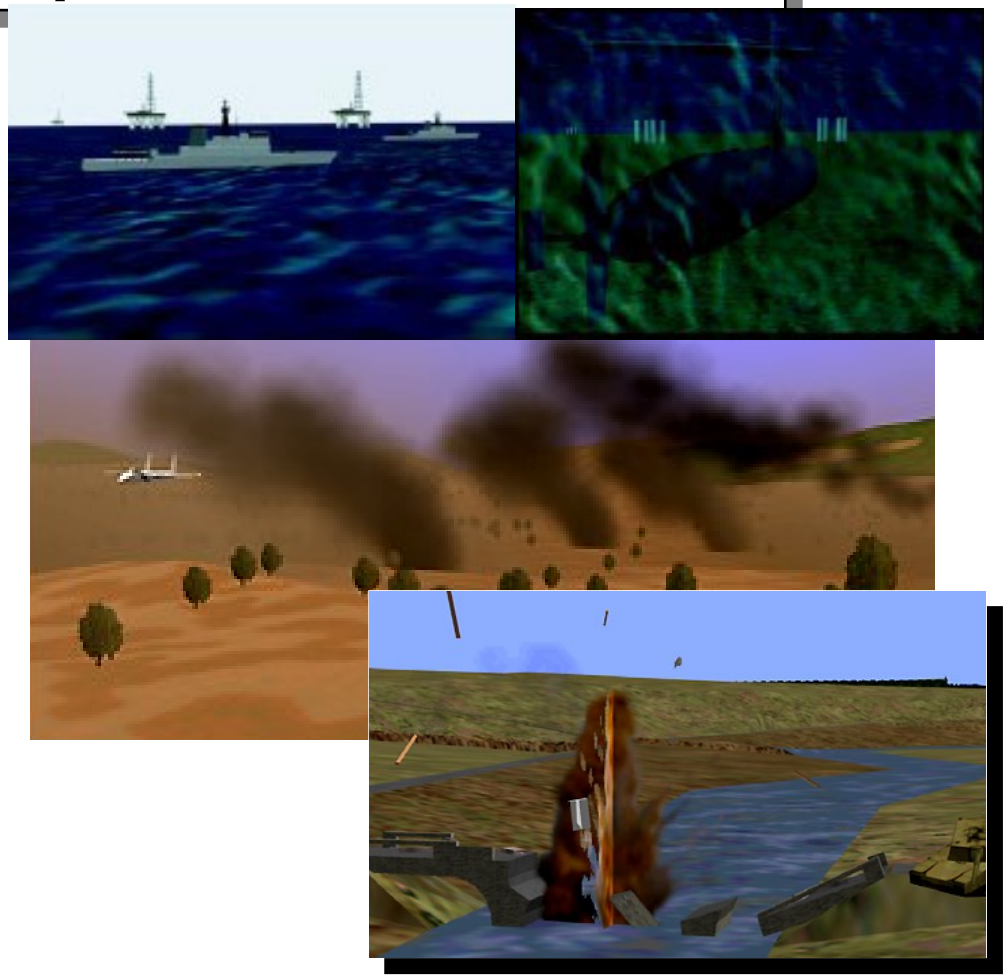


High Fidelity, Immersive Simulation Technology

Synthetic Natural Environment

Integrated environmental models and databases to form a **Realistic,Tactically Significant Dynamic Battlespace**

- **Terrain**
  - **STOW databases**
  - **World Wide TDB terrain generation process**
- **Ocean**
  - **Bathymetry**
  - **Integrated/coupled wind / waves / surf/water column**
- **Atmosphere**
  - **Real-time and historical weather**
- **Dynamic environmental effects in each domain**
  - **Dynamic terrain, dynamic METOC**



JSAF: NWDC's Modeling & Simulation System

- Environmental features include:
  - Topography
  - Bathymetry
  - Obstacles, roads, airfields, ports
  - Population centers
  - Environmental conditions with
    - ATLOS: Acoustic Transmission Loss
    - OASES: Ocean, Atmosphere, Space, Environmental System
  - Geographic areas

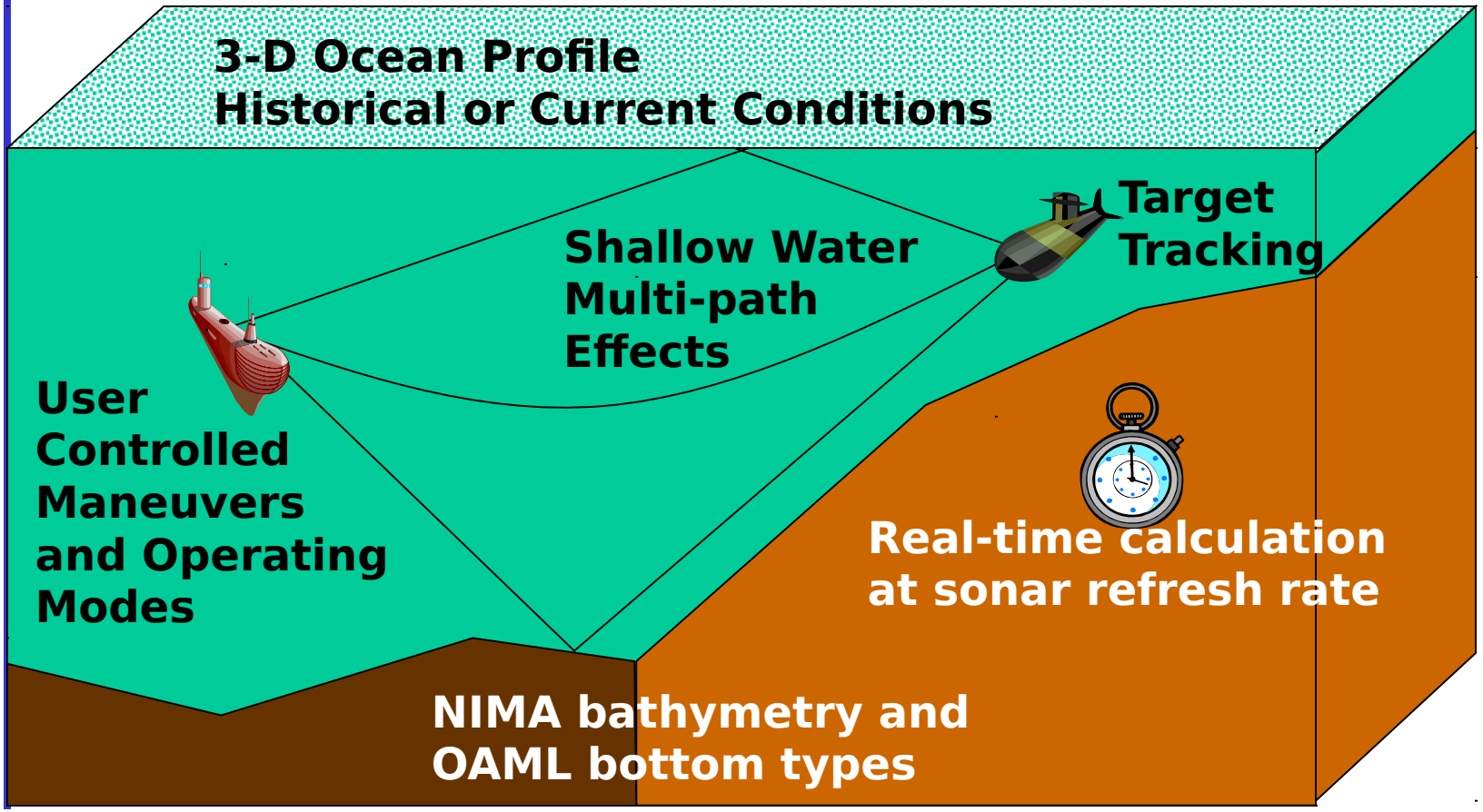
Adding Sonars to JSAF

- **Evolutionary Lifecycle Approach Used**
  - Initial Sonar Modeling - Global Wargame 2001
    - **Passive Sonars Only; Static MIV Tables Pre-computed**
  - Second Spiral - FBE India
    - **Passive and Active Sensors, Simple Sensor Nets**
    - **Limited set of ship radiated noise data files; specific sensor data**
    - **Static, Pre-computed Passive Prop Loss (MIV) and Active Prop Loss/Reverb**
  - Third Spiral - FBE Juliet
    - **Passive and Active Sonars, Complex Sensor Nets; Weapon Sonars**
    - **Continued improvements in characterization of ship noise and sensor performance**
    - **Dynamic Passive Prop Loss; Static Active Prop Loss/Reverb**
  - Forth Spiral FBE Kilo
    - **Passive/Active Sonars, Sensor Nets, Dynamic Passive and Active Prop Loss & Reverb Loss; LFA**
    - **Noise Interference Due to Local Shipping (Noise Masking); Active Ping Intercept**

JSAF Approach to Sensor Modeling

- Collaborative Engineering among
  - NWDC
  - Navy Oceanographer
  - Naval Research Laboratory
  - Defense Modeling and Simulation Office
- Free play environment = no canned results
- Real-time calculation keeps sensor effects in-sync with war game.
- Real-time calculations change with environmental changes and geometry changes according to the environment
- Resolution equivalent to best available tactical decision aids (validated results with PCIMAT/NITES II).
- Model both the sensor effects and track reporting processes.
- Maximize re-use of existing Navy infrastructure.

Example: Real-Time Sonar Modeling



Signal Excess Calculation = SL - TL + (NL - DI) + DT

FLEET FORCES COMMAND NAVY WARFARE DEVELOPMENT COMMAND

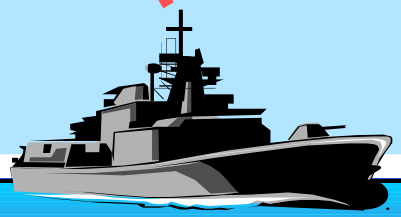
Passive Sonar Model

Contact Report
Target ID
Position
Classification
Category
Line of Bearing

From JSAF

Passive Sonar Parameters

Directivity Index	Det. Threshold
Noise	
Frequency Bandwidth	*Towed Array Length*
Max. Detection Range	*Cable Scope*
Sensor Duration	*Integration Time*
Flow Noise *(On/Off)*	*Sonar State*
Sonar Type	



Passive: SE = SL - TL - DT - NL

Environmental Parameters

ATLoS
Passive Transmission Loss
Bathymetry

JSAF
Precipitation Rate
Distant Shipping Noise Level
Ambient Noise

JSAF Parameters
Ship/Sonar Position (x,y,z)
Target Position (x,y,z)
Ship Course, Speed

JSAF

Radiated Noise Parameters
Narrowband Frequency / Source Level (4 sets)
Broadband Frequency / Source Level
Propulsion Source
Propulsion Source Level
No. of Propellers
Propeller Turns per Knot
Gear Contact Rate

JSAF

Italicized Text - User Modifiable via GUI

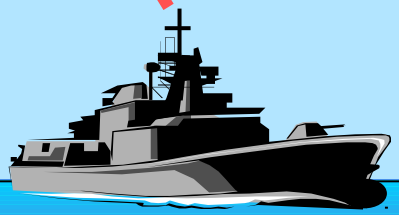
Active Sonar Model

Active Sonar Parameters

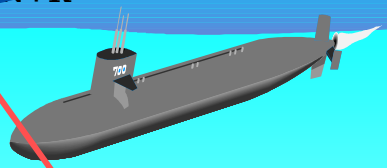
Directivity Index	*Ping Cycle*
Frequency Bandwidth	*Transmit Power (SL)*
Max. Detection Range	*Pulse Length*
Det. Threshold Noise	*Sector Scale*
Det. Threshold Reverb	*Coverage Area*
Flow Noise	*Sonar State*
(On/Off) Sonar Type	

Contact Report
Target ID
Position
Classification
Category

From JSAF



$$\text{Active:}\quad SE = SL + TS - 2TL - (NL + RL + DT_{N+R})$$



Environmental Parameters
Active Transmission Loss
Active Reverberation Loss
Bathymetry
Precipitation Rate
Distant Shipping Noise Level
Ambient Noise

ATLoS

JSAF

JSAF Parameters
Ship/Sonar Position (x,y,z)
Target Position (x,y,z)
Ship Course, Speed

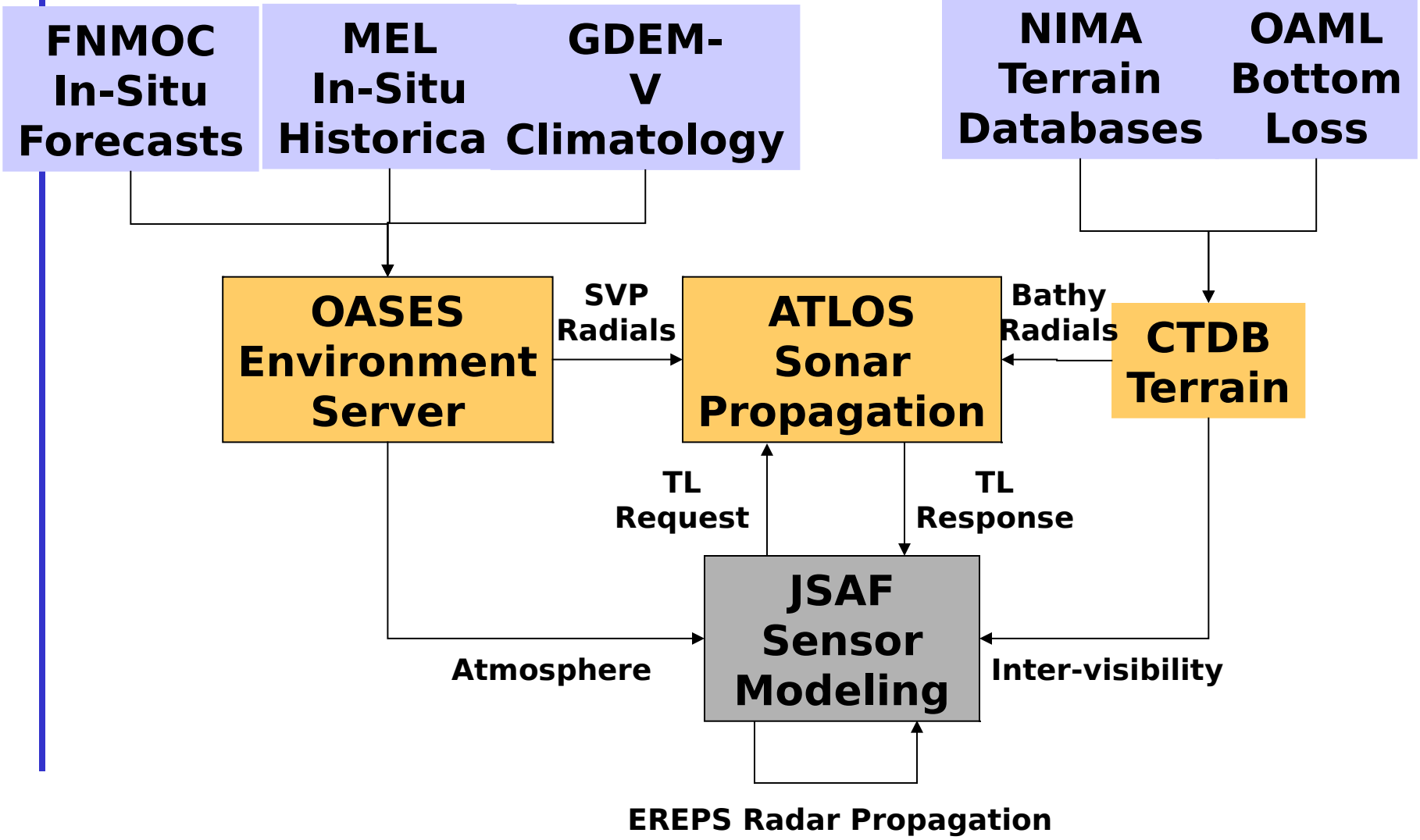
JSAF

Radiated Noise Parameters
Target Strength

JSAF

Italicized Text - User Modifiable via GUI

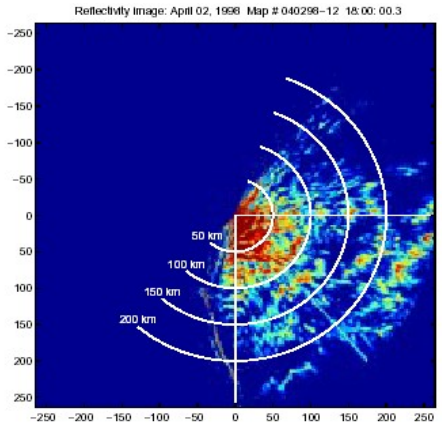
JSAF Propagation Loss Modeling



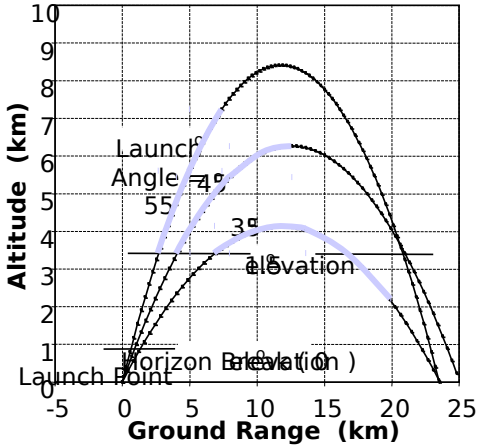
JSAF in Counter Small Boat Study

- **Analysis required adequate fidelity of environment coupled:**
  - **with sensors (sea state vs radar detections)**
  - **with mobility (sea state vs small boat movement)**
  - **with accurate modeling of weapon capabilities (Modeling of stabilized and un-stabilized weapons)**

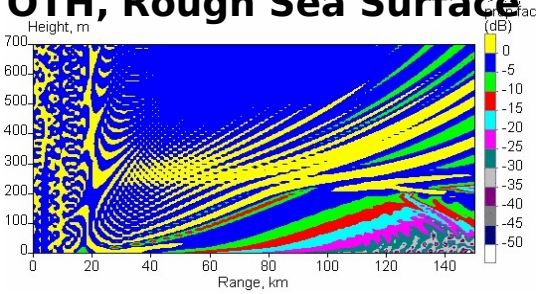
Sea Return Modeling



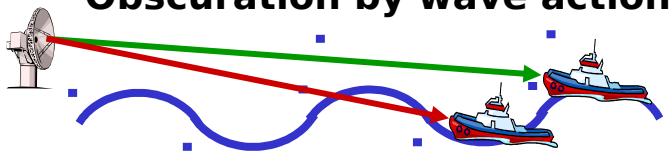
Weapons Ballistics



EREPS Propagation Ducting, OTH, Rough Sea Surface



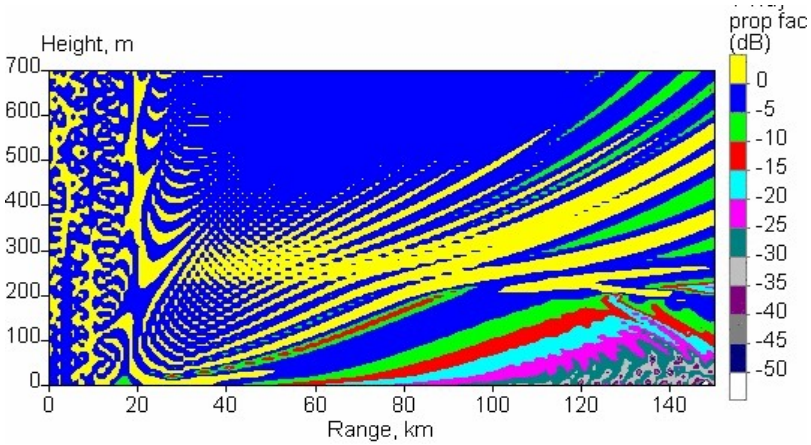
Obscuration by wave action



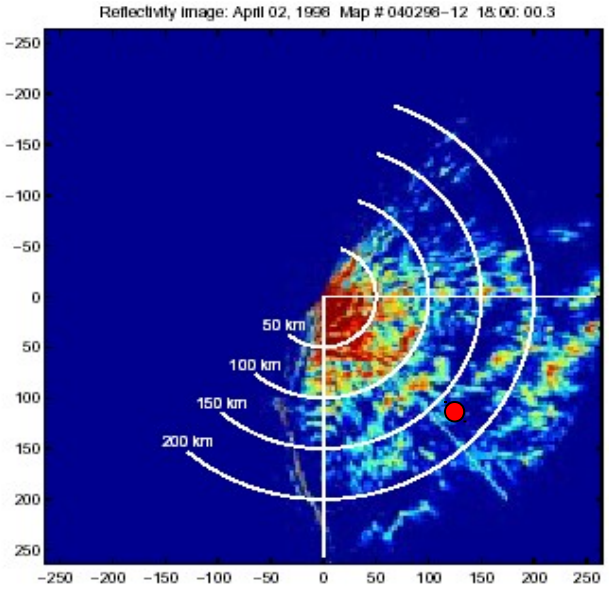
Joint Semi-Automated Simulation (JSAF) - Behaviorally Accurate, Autonomous Forces, Weapons & Sensors fully integrated into the Joint Synthetic Battlespace

Example: Radar Detection in Rough Seas

EREPS Propagation
Ducting, OTH, Rough Surface



Sea Return Modeling



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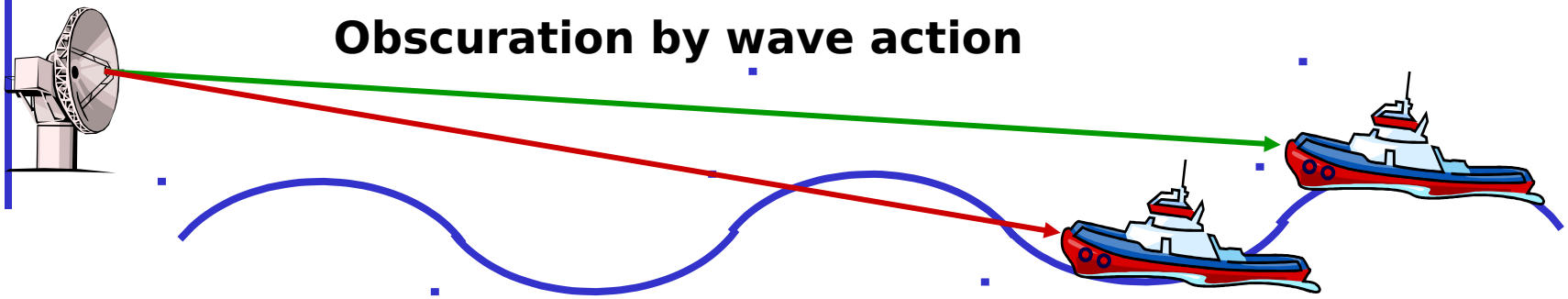

Track Data Fusion